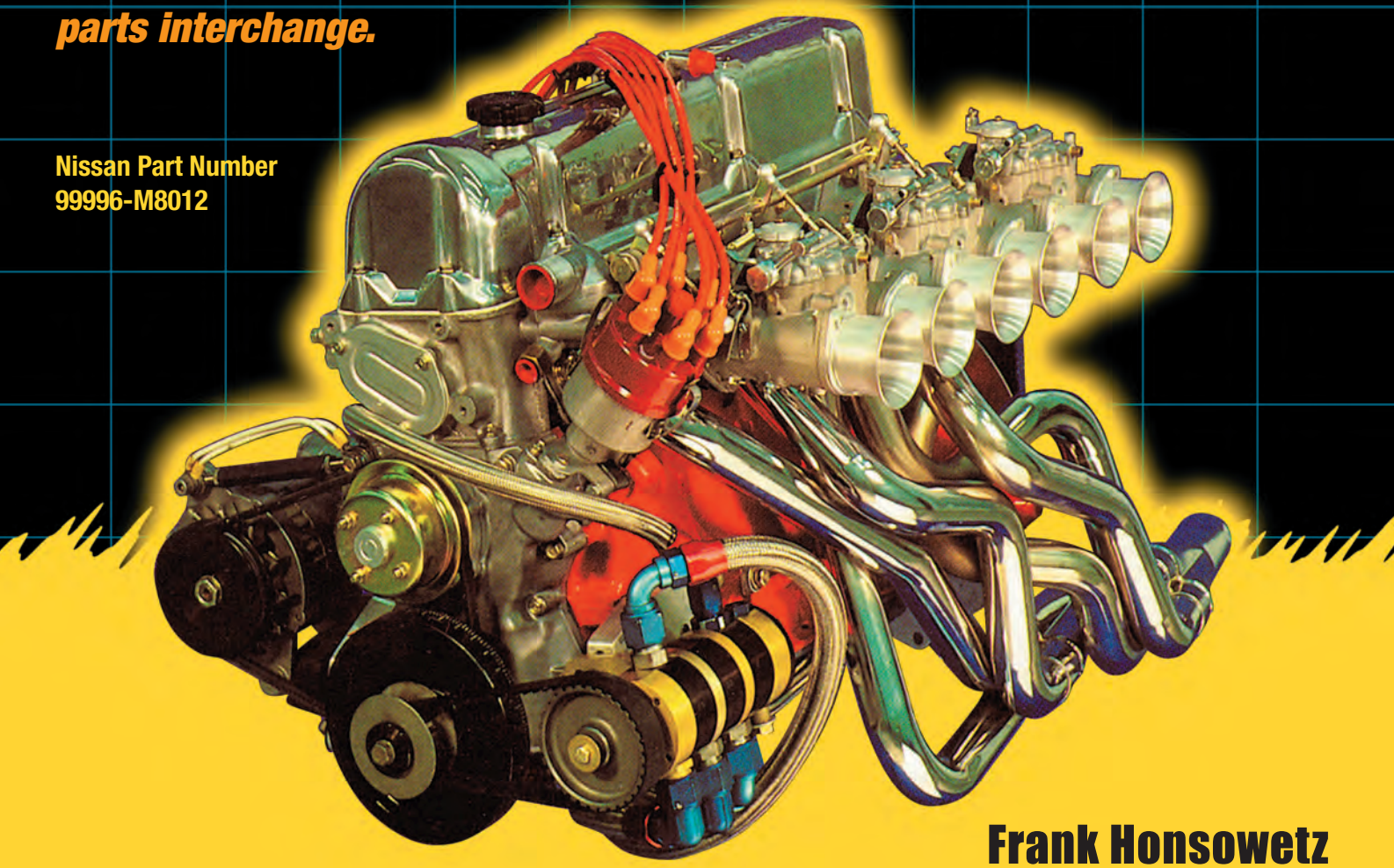
HOW TO MODIFY YOUR NISSAN & DATSUN OHC Engine

L-series engine mods for road racing, drag racing, off-road racing, improved street performance. Details complete mods to engine internals, carburetion & exhaust, plus parts interchange.

Covers 510, 610, 710, 810, 200SX, 240Z, 260Z, 280Z, 280ZX, & pick-up truck engines

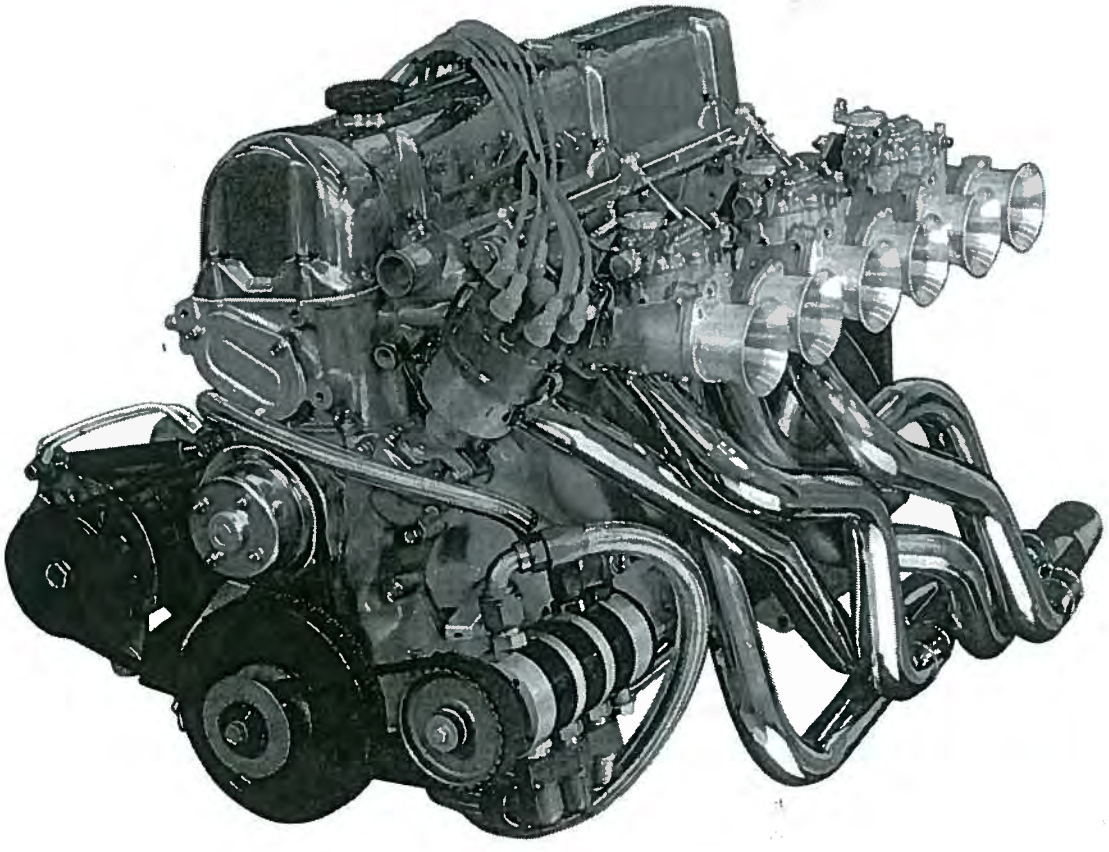
Nissan Part Number
99996-M8012



Frank Honsowetz

HOW TO MODIFY YOUR NISSAN & DATSUN OHC Engine

by Frank Honsowetz



California Bill's
Automotive Handbooks

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Because the quality of parts, materials, and methods are beyond our control, author and publisher disclaim all liability in connection with the use of this information.

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BASIC ENGINE SPECIFICATIONS

Engine	(CID/cc)	Cylinders	Bore (in./mm)	Stroke (in./mm)
L13*	79.1/1296	4	3.268/83	2.358/59.9
L14*	87.2/1428	4	3.268/83	2.598/66.0
L16	97.3/1595	4	3.268/83	2.902/73.7
L18	108.0/1770	4	3.346/85	3.071/78.0
L20A*	121.9/1998	6	3.071/78	2.744/69.7
L20B	119.1/1952	4	3.346/85	3.386/86.0
L24	145.9/2391	6	3.268/83	2.902/73.7
L26	156.3/2562	6	3.268/83	3.110/79.0
L28	168.0/2753	6	3.386/86	3.110/79.0

*Not sold in the U.S.

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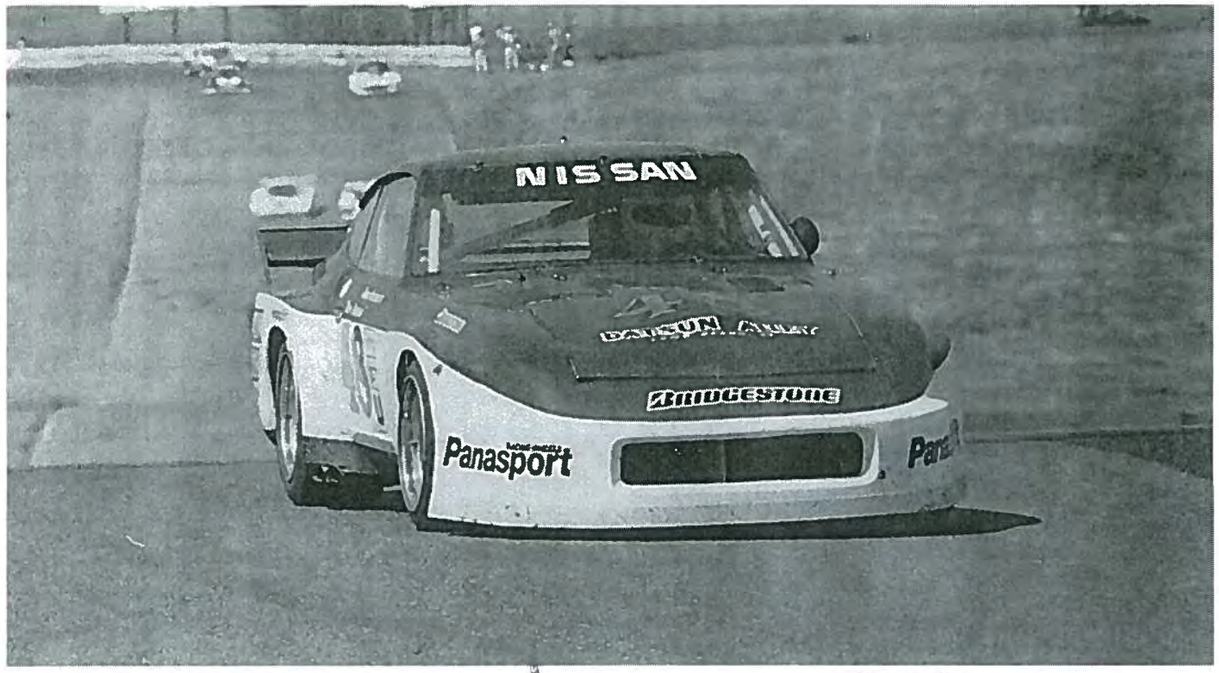
Introduction



Author in his L28-powered IMSA GTU 280Z in turn 7 at Riverside. Engine on cover powered car. Mark Yeager photo.

The 1968 510 was the first Datsun with an L-series engine imported into the United States. It had the 1595cc four-cylinder L16. A 2391cc six-cylinder version, dubbed the *L24*, was introduced in the sensational first 240Z of 1970. Later, the L-series four-cylinder engine grew to 1770cc in 1973 and finally to 1951cc in 1975.

In 1979, the original non-crossflow L-series four-cylinder head was superseded by the Naps-Z head for passenger-car use. However, 1979 and '80 truck models retained the early non-crossflow head. The Naps-Z four-cylinder engine first appeared in 1980. It had a displacement of 2187cc in 1980, growing to 2389cc in late 1983.

The six-cylinder 240Z engine was enlarged to 2562cc in 1974 for the 260Z. The engine was enlarged again to 2753cc and fuel-injected for the 280Z of 1975. From 1975 to 1984, the six-cylinder Z-car engine underwent only one significant change; an optional turbocharged version was introduced in late 1981.

1983 SCCA GT-4 National Champion, Dave Carkhuff wheels his Concord Datsun 510 at Road Atlanta.

Key features of the L-series engine are: a cast-iron, full-skirted block, non-crossflow overhead-cam (OHC) aluminum cylinder head and chain-drive camshaft. The four-cylinder block has five main bearings; the six-cylinder seven. In either case, the center main bearing incorporates the crankshaft thrust bearing.

Up top, the camshaft is supported by

*Naps-Z was the abbreviation for Nissan Anti-Pollution systems.

removable aluminum cam towers. The cam actuates the valves through rocker arms. The oil pump is externally mounted to the base of the cast aluminum front cover and shares a common drive spindle with the distributor assembly.

RACING HISTORY

The Datsun 510 and 240Z were immediate successes in sports-car road racing. In the United States, Datsun supported the winning efforts of Brock Racing Enterprises (BRE) and Bob Sharp Racing. In 1970, BRE won the first of 10 consecutive "Z-Car" Sports Car Club of America (SCCA) National Championships. The 510 was equally successful. Bob Sharp won National Championships in 1971 and 1972, driving a 510.

The highlight of the 510's racing career was two consecutive SCCA 2.5 Trans-Am Championships in 1971 and '72. In doing so, the BRE 510s beat European performance-image sedans such as BMW and Alfa Romeo. During the same period, Bob Sharp Racing began a winning record in L-series powered Datsun sedans and Z-cars that continued for 16 years.

Throughout the mid and late '70s, Bob Sharp continued racing and winning with Datsuns in both SCCA and International Motor Sports Association (IMSA) events. Several other Datsun teams were successful as well, including those of Walt Maas and Frank Leary with FAR Performance.

In 1978, Dick Roberts, Datsun Competition Department Manager—Nissan Motorsports Department up to September 1985—promoted Don Devendorf and the Electramotive team from racing small Datsun sedans to a Z-car for competition in the IMSA GTU category—Grand Touring under 2.5 liters. Devendorf and his partner, John Knepp, then accelerated the development of the L-series engine.

Bob Sharp Racing and Electramotive both campaigned GTU Z-cars in the IMSA series in 1979. Devendorf's Electramotive team won the championship that year. Sharp's team, with Paul Newman driving, also competed in SCCA events, winning the C-Production (C/P) National Championship the same year.

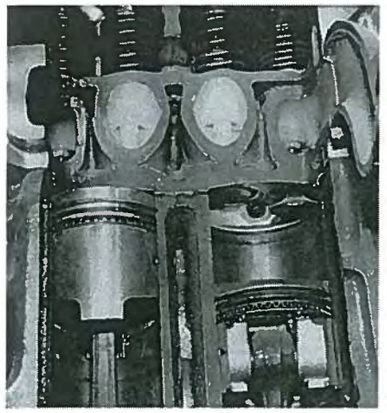
From 1971 to 1981, Datsun sedans powered by L-series four-cylinder engines won 10 National Championships. Dave Frellsen and Bob Sharp Racing were

BASIC ENGINE SPECIFICATIONS

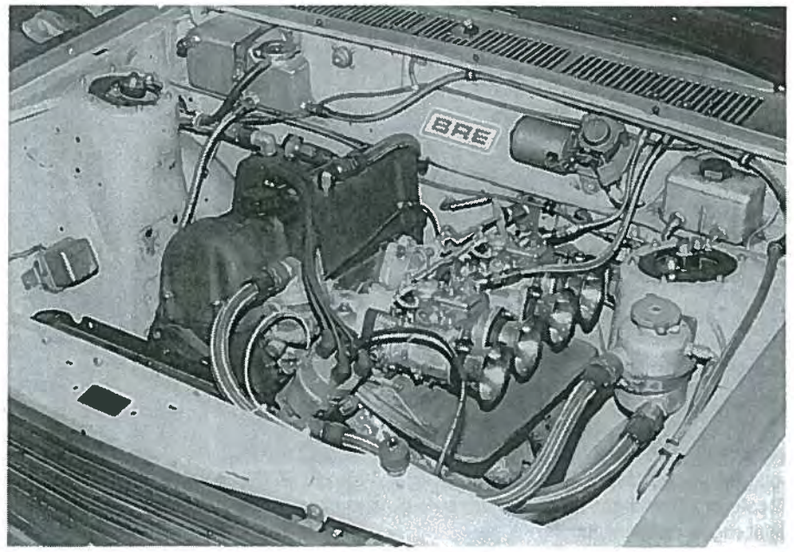
Engine	Displacement cc/inch3	Bore mm/in.	Stroke mm/in.
L16 (four-cylinder)	1595/97.3	83/3.268	73.7/2.902
L18 (four-cylinder)	1770/108.0	85/3.346	78.0/3.071
L20B/Z (four-cylinder)	1951/119.1	85/3.346	86.0/3.386
Z22 (four-cylinder)	2187/133.4	87/3.425	92.0/3.622
Z24 (four-cylinder)	2389/145.7	89/3.504	96.0/3.779
L24 (six-cylinder)	2391/145.9	83/3.268	73.7/2.902
L26 (six-cylinder)	2562/156.3	83/3.268	79.0/3.110
L28 (six-cylinder)	2753/168.0	86/3.386	79.0/3.110
L16 + 1mm/0.040-in. overbore	1636/99.8	84/3.307	73.7/2.902
L18 + 1mm/0.040-in. overbore	1816/110.8	86/3.386	78.0/3.071
L20B + 1mm/0.040-in. overbore	2005/122.3	86/3.386	86.0/3.386
Z22 + 1mm/0.040-in. overbore	2230/136.1	88/3.464	92.0/3.622
Z24 (4) + 1mm/0.040-in. overbore	2438/148.7	90/3.543	96.0/3.779
L24 (6) + 1mm/0.040-in. overbore	2454/149.8	84/3.307	73.7/2.902
L26 + 1mm/0.040-in. overbore	2630/160.5	84/3.307	79.0/3.110
L28 + 1mm/0.040-in. overbore	2824/172.3	87/3.425	79.0/3.110

BORE/STROKE COMBINATIONS

Bore/Stroke	Displacement cc/In.3	Bore mm/in.	Stroke mm/in.
L16 Bore/L18 Stroke	1686/102.9	83/3.268	78.0/3.071
+ 1 mm/0.040-in. overbore	1731/105.6	84/3.307	78.0/3.071
L18 Bore/L16 Stroke	1672/102.0	85/3.346	73.7/2.902
+ 1 mm/0.040-in. overbore	1716/104.7	86/3.386	73.7/2.902
L20B/ZBore/L22Z Stroke	2086/127.2	85/3.346	92.0/3.622
+ 1 mm/0.040-in. overbore	2141/130.6	86/3.386	92.0/3.622
Z22 Bore/L20B/Z Stroke	2052/125.2	87/3.425	86.0/3.386
+ 1 mm/0.040-in. overbore	2089/127.4	88/3.464	86.0/3.386
Z24(4) Bore/L22Z Stroke	2287/139.6	89/3.504	92.0/3.622
+ I mm/0.040-in. overbore	2335/142.3	90/3.543	92.0/3.622
Z24(4) Bore/L20B/Z Stroke	2142/130.7	89/3.504	86.0/3.386
+ 1 mm/0.040-in, overbore	2186/133.4	90/3.543	86.0/3.386
L28 Bore/L20A Stroke	2434/148.5	86/3.386	69.7/2.744
+ 1 mm/0.040-in. overbore	2492/152.0	87/3.425	69.7/2.744
L28 Bore/LD28 Stroke	2901/177.0	86/3.386	83.0/3.268
+ 1 mm/0.040-in. overbore	2967/181.2	87/3.425	83.0/3.268
+ 3 mm/0.118-in. overbore (Nissan Motorsports "Big Bore Kit" 99996-28BBK)	3098/189.0	89/3.504	83.0/3.267
L24/26 Bore/LD28 Stroke	2699/164.7	83/3.268	83.0/3.268
+ 1 mm/0.040-in. overbore	2766/168.7	84/3.307	83.0/3.268
L28 Bore/L24 Stroke	2575/157.1	86/3.386	73.7/2.902
+ 1 mm/0.040-in. overbore	2636/160.8	87/3.425	73.7/2.902

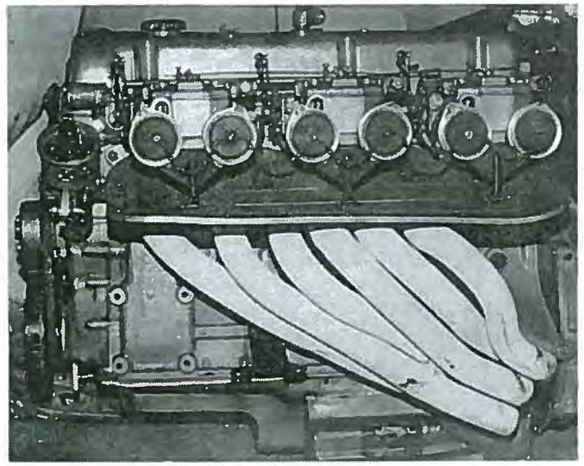


Sectioned L28 shows pistons, rods and cylinder-head layout of L-series Nissan/Datsun engine.

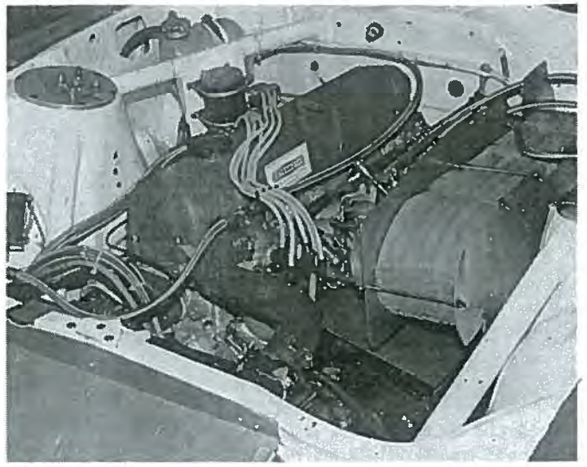


Original BRE 510 car-number 46 as it exists today: Car is used for shows and displays.

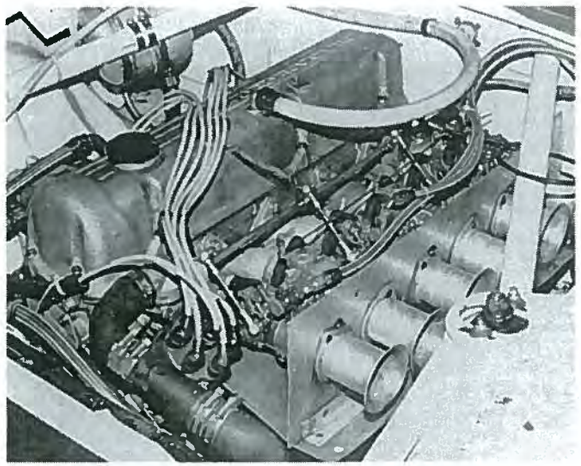
From left to right John Morton, Bob Sharp and Dan Parkinson lead start of 1971 C-Production National Championship runoff. John Morton emerged the victor.



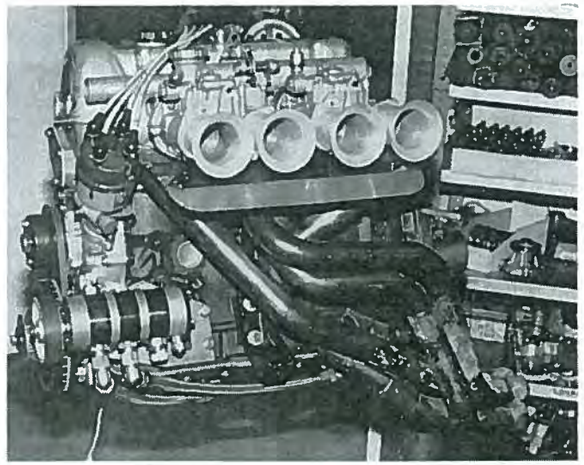
As of 1985, Gerry Mason Sr. and Jr. were competitive in SCCA GT-2 category. Their Z-car, which was built by BRE, uses many of the original engine components.



In 1983, Jim Fitzgerald competed in SCCA National Championships with a 280ZX powered by Electramotive-built L28.



L28 with Mikuni 50 PHH carburetor powered author's IMSA GTU Z-car.



Bill Long's SCCA GT-3 spec L20B. Engine uses early FIA Group-2 cylinder head and 50mm carburetors.

responsible for eight of the 10 wins.

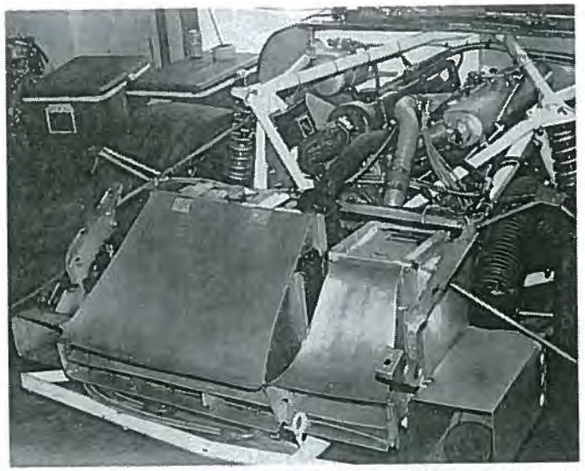
In 1981, Datsun introduced the 280ZX Turbo and, during the 1981—83 race seasons, moved to higher racing categories. As a result, the Datsun 280ZX Turbo competed against V8-powered Detroit pony cars and exotic European sports cars.

In 1982, Devendorf won the IMSA GTO (Grand Touring over 2.5 liter) Championship in an Electramotive-prepped Turbo-ZX. During the same year, Gene Crowe of Bob Sharp Racing developed a Turbo-ZX that dominated the SCCA GT-1 category. Sharp's car, piloted by Paul Newman, was entered in SCCA Trans-Am races and in 1982 at Brainerd Raceway, he won handily. Another tough competitor, Frank Leary, also built a Turbo-ZX and entered it in selected IMSA and SCCA events.

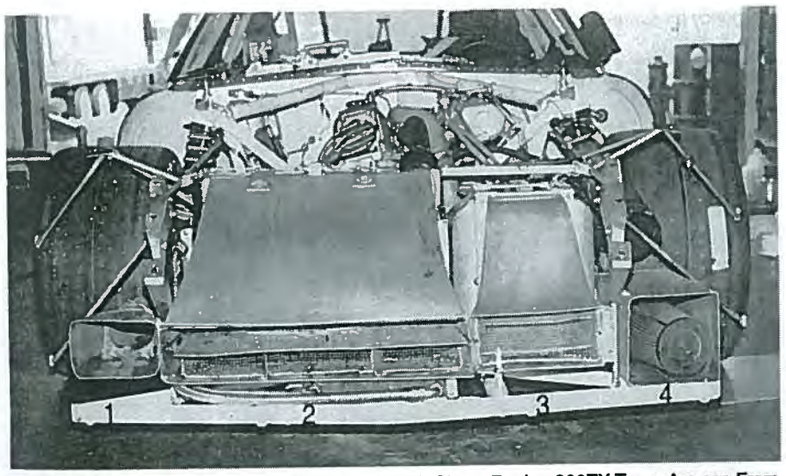
In the early '80s, teams such as Carney/Davenport, Logan Blackburn, and Leitzinger Racing also took advantage of Electramotive's engine technology to win numerous IMSA races. In 1982, the Don Preston prepared Carney/Davenport 280ZX finished fourth overall in the 24 Hours of Daytona. In 1984, Morris Clement upheld Datsun's winning image at the SCCA National Championships in his 2.8-liter six-cylinder L-series-powered 280ZX.

With turbocharged race cars becoming more dominant, Don Preston developed a turbo 1.8-liter four-cylinder 200SX for the

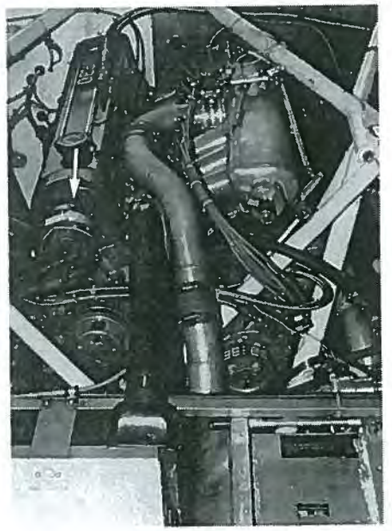
Spencer Low compete with 2.4-liter-powered Class 7S off-road truck. Look carefully and you can see engine buried under all those struts and shock absorbers. Engine develops excellent power over broad rpm range.



Bob Sharp Racing built 280ZX Turbo that Paul Newman drove in 1983 Trans-Am Series.



Complex ducting is required for turbocharged Bob Sharp Racing 280ZX Trans-Am car. From left to right, ducting is for: (1) brakes, (2) radiator, (3) turbocharger intercooler and (3) induction air intake with (4) air cleaner.

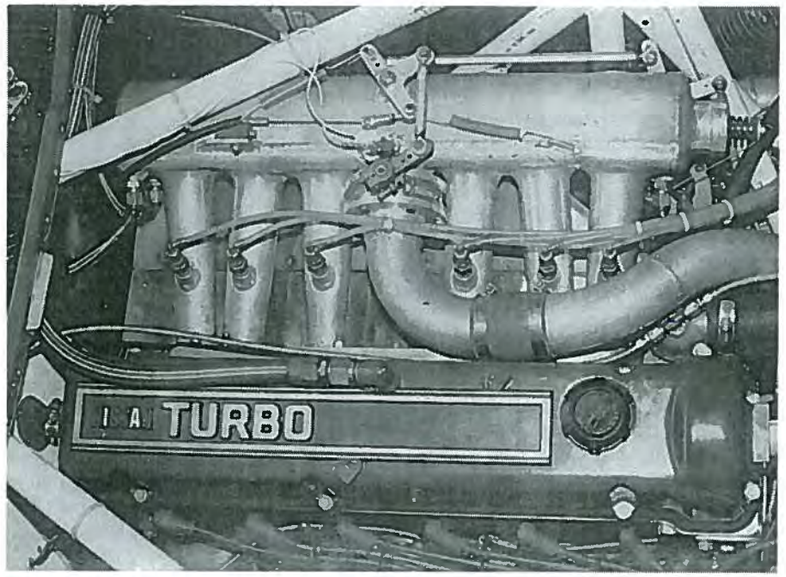


Gene Crowe relocated distributor to front of rocker-arm cover, where it is driven off nose of cam. Bosch fuel-injection pump is mounted in original distributor location.

Carney/Davenport Team. George Alderman also joined the "get a turbo, go faster" group with a 2.0-liter six-cylinder (L20A) turbocharged 280ZX.

Datsun continued to win National Championships with L-series, four-cylinder engines. Mike Rickman, Rob Dyson and Bill Coykendall all won with L-series engines in 200SXs. Some of the engines for these cars were built by John Caldwell, a long-time Nissan engine builder whose initial association with Datsun engines dates back to BRE, as do other successful Nissan/Datsun engine builders Floyd Link and Electramotive's John Knepp. The longtime Nissan/Datsun race history was furthered when Dave Carkhuff won a 1983 National Championship in a Datsun 510 that was more than 10 years old. Bob Sharp's son, Scott, again demonstrated the performance of early Z's with L6 engines by winning the 1986 GT-2 National Championship with one of his father's earliest Z cars. In 1998 Jim Goughary won the GT-2 National Championship with a L6 powered 1995 model Nissan 300ZX. The current total of SCCA National Championships won by L-series engine now stands at an amazing 34.

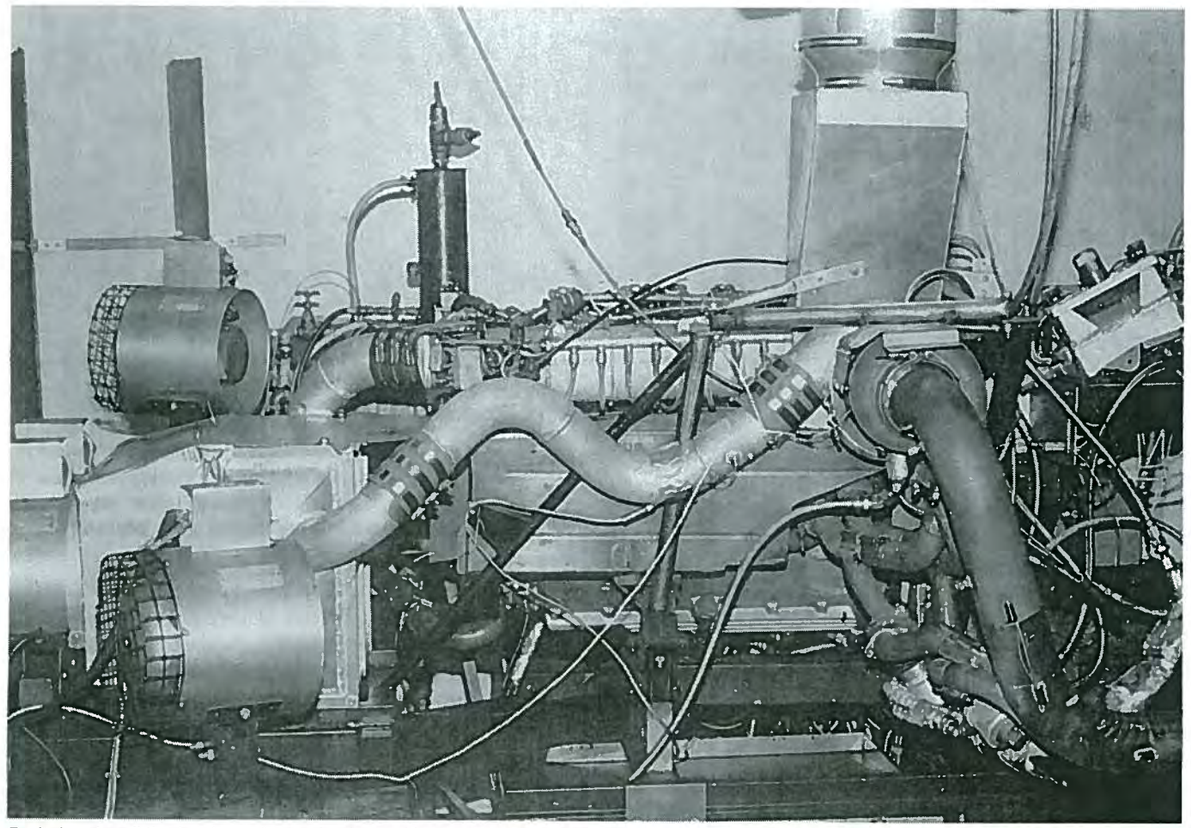
This Book—I organized this book around each major component or system. For example, I start with the foundation of the engine, the block, then proceed to discuss all other engine components or systems and how to choose, apply and prepare them for specific high-performance applications. Once you've chosen and prepared the engine components, I show how to preassemble an engine to check critical clearances, fits and



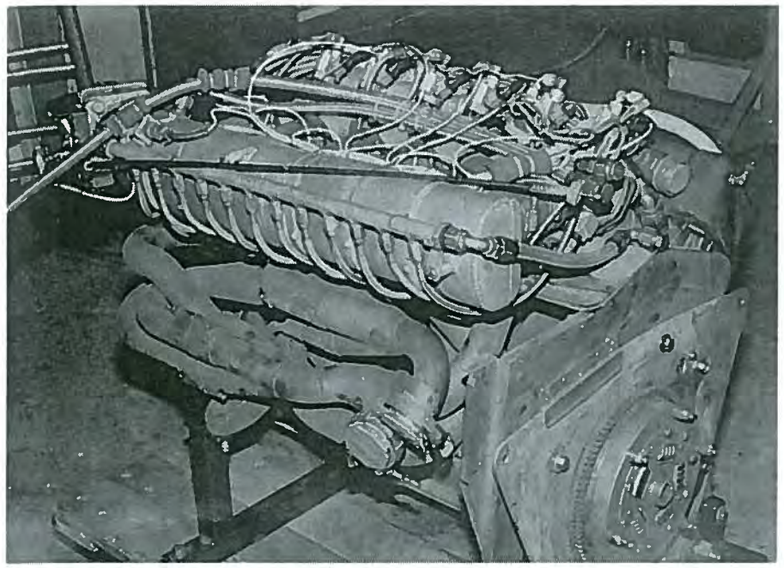
Bob Sharp Racing built induction system for 2.5-liter 0.060-in. overbore turbocharged L24. Valve spring at front of plenum chamber is part of emergency pressure-relief valve.

relationships between certain components. I then go through final engine assembly step by step.

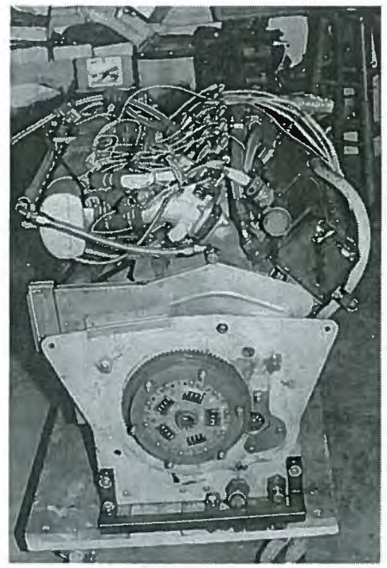
As a companion to this book, get Fisher Books' *How to Rebuild Your Nissan/Datsun OHC Engine*, Nissan part number 99996-M8013. Where I've assumed a high degree of prior knowledge, the companion rebuild book provides great detail on the rebuilding of the L-series Nissan/Datsun engine. Coverage includes troubleshooting, engine removal, teardown, inspection and reconditioning, assembly and installation.



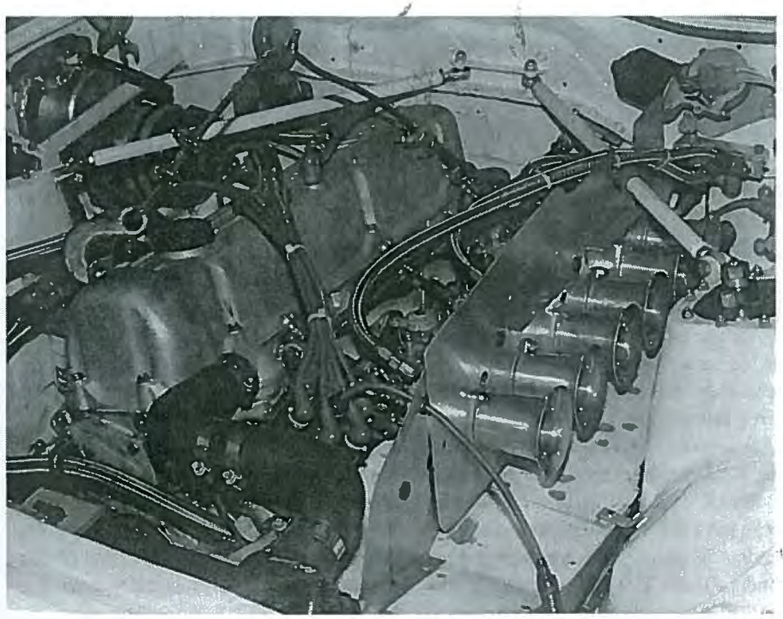
Buried under all the hardware is a turbocharged L28. Engine is mounted on Electramotive's dynamometer and outfitted as it would be in Don Devendorf's IMSA GTO race car.



Devendorf's own electronic fuel-injection system enhanced performance of his IMSA GTO racecar.



Turbocharged L28 was installed in Devendorf's 280ZX at angle shown. Engine plate mounted to rear face of engine block secures engine to chassis.

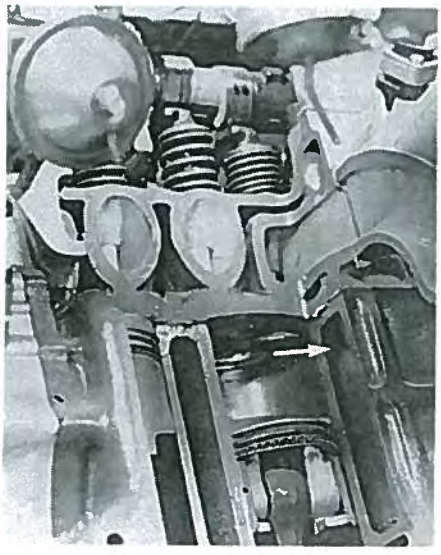


Morris Clement's crew attached lifting hoist to remove practice engine. "Good" engine went in its place for running 1984 SCCA National Championships, which he won.

CHAPTER ONE

Cylinder Block

Morris Clement en route to 1984 SCCA GT-2 National Championship behind wheel of his 280ZX.



Cut-away engine reveals non-Siamesed cylinder walls (arrow) of early L28 block.

Unlike most other manufacturers' engine blocks, all Nissan/Datsun blocks are suitable for use in competition. This is fortunate because Nissan does not produce heavy-duty or racing engine blocks. There's no need to.

All L-series engines share the same basic block design except for that used in the 280ZX Turbo. The first L28 Turbo blocks have the front three and rear three cylinders *Siamesed*. Webs are cast between cylinders 1 and 2, 2 and 3, 4 and 5, and 5 and 6. Although this improved block rigidity, it was thought that the webs inhibited coolant flow around the Siamesed cylinders.

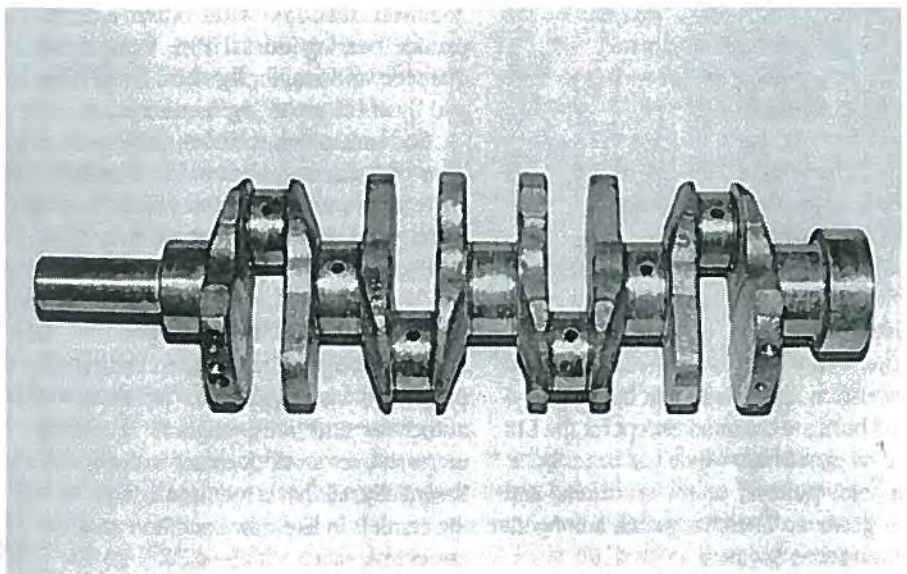
To improve coolant circulation, a casting change was made. On the L28 Turbo block 11010-P9080, introduced in the 280ZX Turbo in December, 1980, and non-turbo L28s in July, 1981, slots were put in the Siamesed cores to provide coolant passages between the cylinders. Curiously enough, there were no incidents of piston-bore scuffing with the earlier L28 unslotted Siamesed blocks which would have indicated the need to use the later block for racing. However, the turbo block was used exclusively on Don Devendorf's Electramotive 600HP 280ZX Turbo L28. It was also used in the Bob Sharp Racing 280ZX Turbo.

Over the years there have been numerous changes to the size and location of

CHAPTER TWO

Crankshaft

Mike Rickman emerged the winner in SCCA's GT-3 class in 1983 at the wheel of his L20B-powered 200SX.



Fully counterweighted L20B crankshaft can be modified for racing. Crank can be substituted for Z20 crank that is not fully counterweighted.

All Nissan/Datsun OHC L-series engines have forged-steel crankshafts with cross-drilled main-bearing journals. Most of these crankshafts are suitable for racing applications.

There are a few crankshafts that are not desirable for racing or are easily replaced with a better one. The 1982–83 Maxima L24E crank has smaller connecting-rod journals than the early 240Z L24 crank. So, if you have the L24E Maxima engine you may want to use the 240Z crank and rods. The early L16 and late Z20 (Naps-Z) four-cylinder crankshafts are not fully counterweighted, while the later L16 and earlier L20B cranks are. Again, this is an easy substitution. The Z22 and Z24 four-cylinder crankshafts are also only partially counterweighted but there are no

CHAPTER THREE

Pistons & Rings

Don Devendorf won 1982 IMSA GTO Championship in his "awesome" 280ZX Turbo. Car was so competitive it out-qualified many GTP cars. Mark Yeager photo.

Nissan does not offer "hot-rod" replacement cast pistons, but a wide variety of pistons from L-series engines are interchangeable. This piston interchangeability allows for many practical bore-size and compression-ratio combinations.

However, cast pistons, regardless of manufacturer, have limitations. For instance, load limits can be exceeded with a high compression ratio or under turbocharger boost. The detonation that may result, especially from today's low-octane pump gas, will destroy a cast piston.

The limitations of a cast Nissan piston are hard to estimate, but it's safe to assume that the average non-high-compression street-car engine will survive with cast pistons. An exception may be a turbocharged engine with boost pressures exceeding 12 psi.

By using the accompanying piston comparison chart or Nissan/Datsun service manuals, you can probably find a suitable cast piston for most applications. An important consideration when using pistons not meant for your engine is to use the ring set specified for the pistons, not those listed for the engine. This is important because the width of the rings must match the width of the grooves in the piston.

STOCK NISSAN PISTON RINGS

Standard Nissan/Datsun piston rings are ideal for most street applications. As discussed in Chapter 1, bore finish must match ring-face material, regardless of the type of ring used. A competent engine machinist will know what type of hone finish to use, providing the piston and-ring set accompanies the block. With this in mind, send all three items—pistons, rings and block—to the machine shop when having a

HOW TO MODIFY YOUR

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OHC Engine

Electramotive IMSA GTO 280ZX driven by Don Devendorf.

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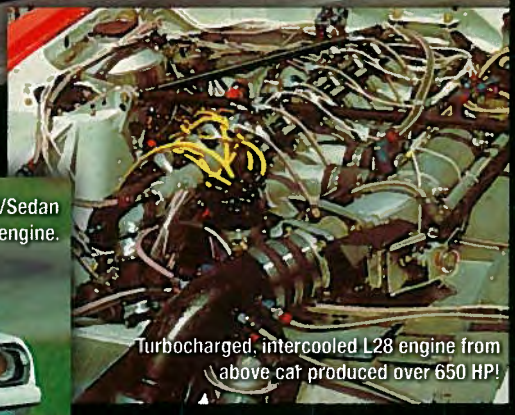
Bob Sharp Racing 200SX SCCA B/Sedan powered by L20B engine.


Turbocharged, intercooled L28 engine from above car produced over 650 HP!

LZ22-powered Class-7 4X4 off-road-racing truck. Photo by Tom Monroe.

Gene Crowe, Crew Chief, Bob Sharp Racing says, "Anyone interested in building, developing or racing the Nissan L-series engine must have this book."

Don Devendorf and John Knapp of Electramotive say, "This book is a great investment for Nissan racers and enthusiasts. Contains the latest information on all 'hot-tip' parts. All aspects of modifying the Nissan/Datsun L-series engines are covered."

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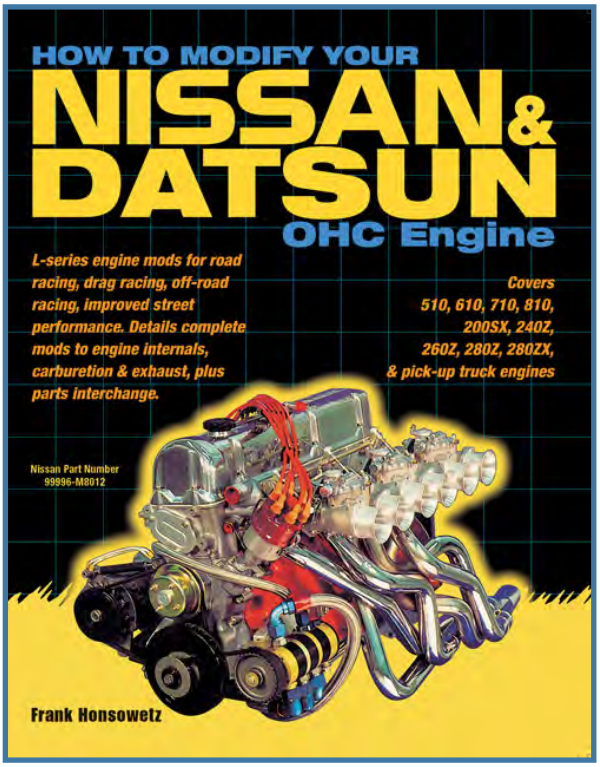
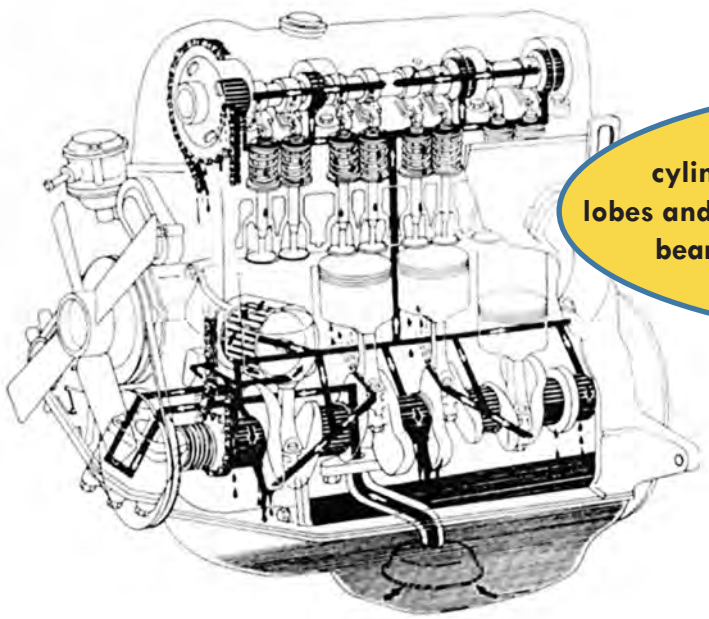
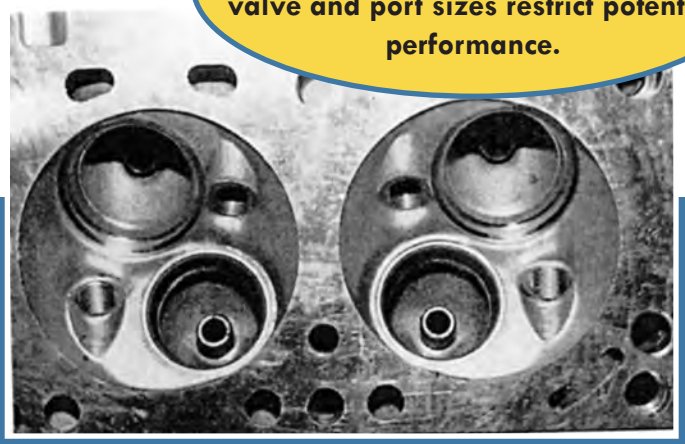




Production oiling system of four-cylinder L-series engines use direct oiling for cam lobes and rockers arms. Note that the number 2 and 4 main bearings feed two connecting-rod bearings each. Drawing courtesy Nissan.

Twin-plug, hemi-chamber of Naps-Z head is desirable, but valve and port sizes restrict potential performance.



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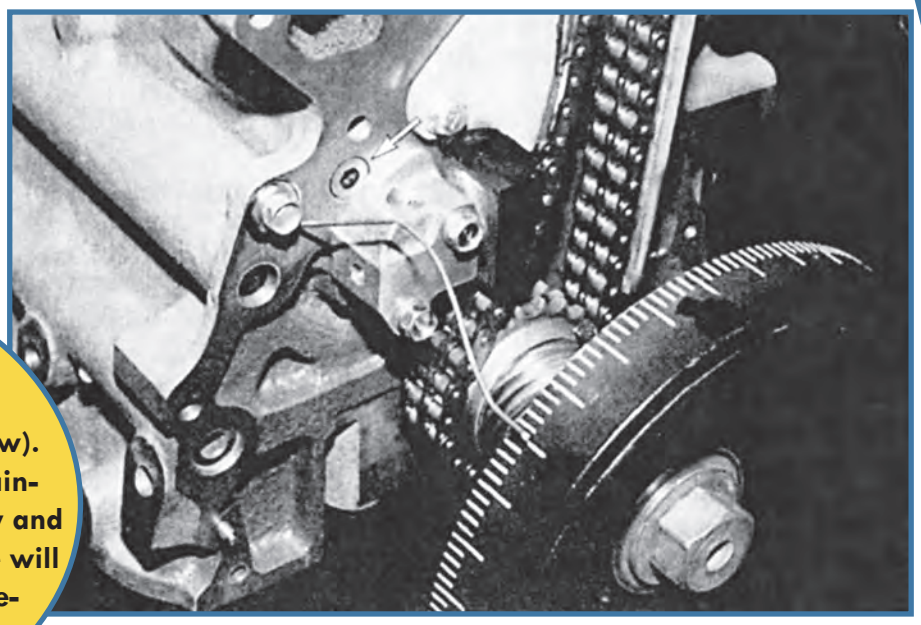
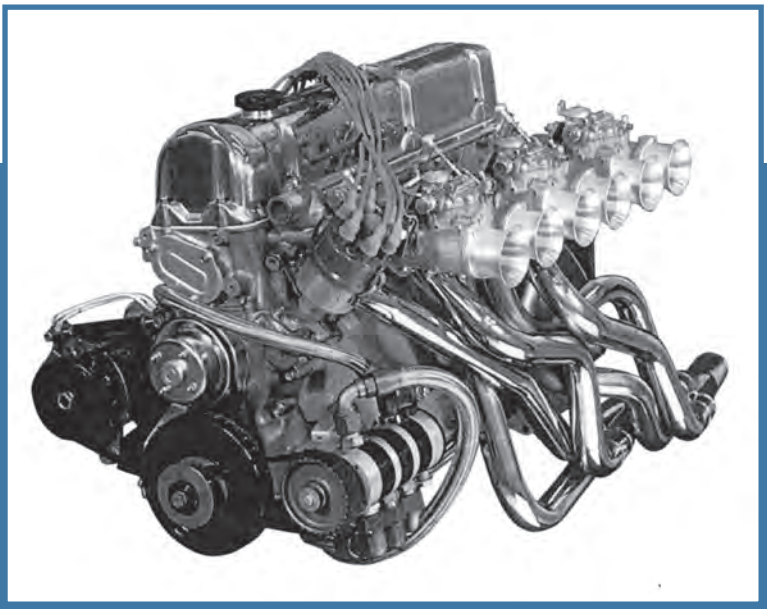
At right is stock L16/ L24 connecting rod. At left is prepped rod. Note pin-hole location (arrows). A similar hole (not visible) is on the opposite side of the pin boss in the same location.



Note oil-gallery plugs in front of block. Top plug is installed as it must be–flush with front of block (arrow). Plug seals main oil gallery. Remaining two plugs seal oil-pump supply and discharge galleries because engine will use dry-sump oil system. Consequently, these passages must be plugged.

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